NM Small Business Innovative Research Focused Topic (SBIR)

Richard Key

SBIR PROJECTS

AND THE

NEW MILLENNIUM PROGRAM

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SBIR PROJECTS AND THE NEW MILLENNIUM PROGRAM
Discussion Agenda

- SBIR PROGRAM STRUCTURE
  - TOPICS / SUBTOPICS
  - NEW MILLENNIUM PARTICIPATION
- TECHNOLOGY PIPELINE
- NEW MILLENNIUM SBIR FOCUSED TOPIC
  - *MULTISPACECRAFT SYSTEMS*

SBIR TECHNICAL TOPICS

- The NASA SBIR solicitation is organized by topics
  - General Topics
  - Focused Topics
- Topics are comprised of subtopics
- One or more NASA Centers manage each subtopic
- Proposals are made to subtopics
  - a proposal can be sent to only one subtopic
- One or more NASA Centers will participate in the proposal review processes

PRELIMINARY 1996 SBIR TOPICS

N M P

Aeronautical Propulsion and Power
Aerodynamics and Acoustics
Aircraft Systems, Subsystems and Operations
Materials and Structures
Teleoperators and Robotics
Mission Operations and On-Board Autonomy
Instrumentation, Sensors and Optics
Spacecraft and Sensor Platforms
Space Power
Space Transportation and Propulsion
Human Habitability and Biology in Space
Ground Operations and Support
Satellite and Space Systems Communications
Space Applications and Micro-Gravity Sciences

GENERAL TOPICS

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General Aviation
High Speed Research
New Millennium Multispacecraft Systems
Interferometry
Reusable Launch Vehicle Fuels and Space Propellants
Large Aperture Space Telescopes
Mission to Planet Earth/Commercial Remote Sensing

FOCUSED TOPICS

Each topic is divided into subtopics that describe certain technical problems and program needs for which innovative R&D solutions are desired. Subtopics include current and foreseen agency program needs and priorities. All subtopics are candidates for project selection and there are no quotas for the selection of Phase I proposals in any subtopic. The technical descriptions identify the NASA Installations that are primarily responsible for the subtopics. Every Installation is informed of and has access to all proposals received, and may evaluate and recommend for selection any responsive proposal.

N M P

SBIR PROJECTS PARTICIPATION IN THE NEW MILLENNIUM PROGRAM

- THE FY'96 SBIR SOLICITATION WILL HAVE SOME DIFFERENCES FROM FY'95
  - Subtopics will be updated and reorganized
  - New Focused Topics and corresponding subtopics will be added

- NEW MILLENNIUM PERSONNEL WILL REVIEW ALL RELEVANT FY'96 PROPOSALS

- ALL PROPOSERS ARE WELCOME TO PARTNER WITH THE NEW MILLENNIUM PROGRAM, EVEN IF THEY DO NOT PROPOSE TO THE MULTISPACECRAFT SYSTEMS FOCUSED TOPIC

BACKGROUND

NASA's vision for space exploration and Earth science programs of the 21st century is bold. Exciting, affordable missions with highly focused objectives will be launched on a frequent basis. Revolutionary new technologies and innovative mission / system architectures will reduce the costs and enhance the capabilities of these missions. Numerous "microspacecraft" carrying advanced miniaturized instruments will return a continuous flow of information about their discoveries to create a virtual presence in space. A continuum of missions will accelerate our understanding of the Earth, the solar system, and the universe. New computing and information systems technologies will make it possible for everyone, not just scientists, to visit planets, comets, and asteroids, to study the cosmos and explore the universe. These unprecedented capabilities will produce new insights that further stimulate public interest and provide new learning opportunities for students at all levels. The wealth of new scientific information and its widespread dissemination, combined with the rapid development, deployment and transfer of new technology, will strengthen U.S. leadership in space science and technology.

INTRODUCTION

The New Millennium Program (NMP) will lead a technological revolution to enable exciting, affordable space and Earth science missions in the 21st century. The NMP will identify, develop and flight validate breakthrough technologies which can significantly reduce life-cycle costs of future science missions while enhancing their capability.

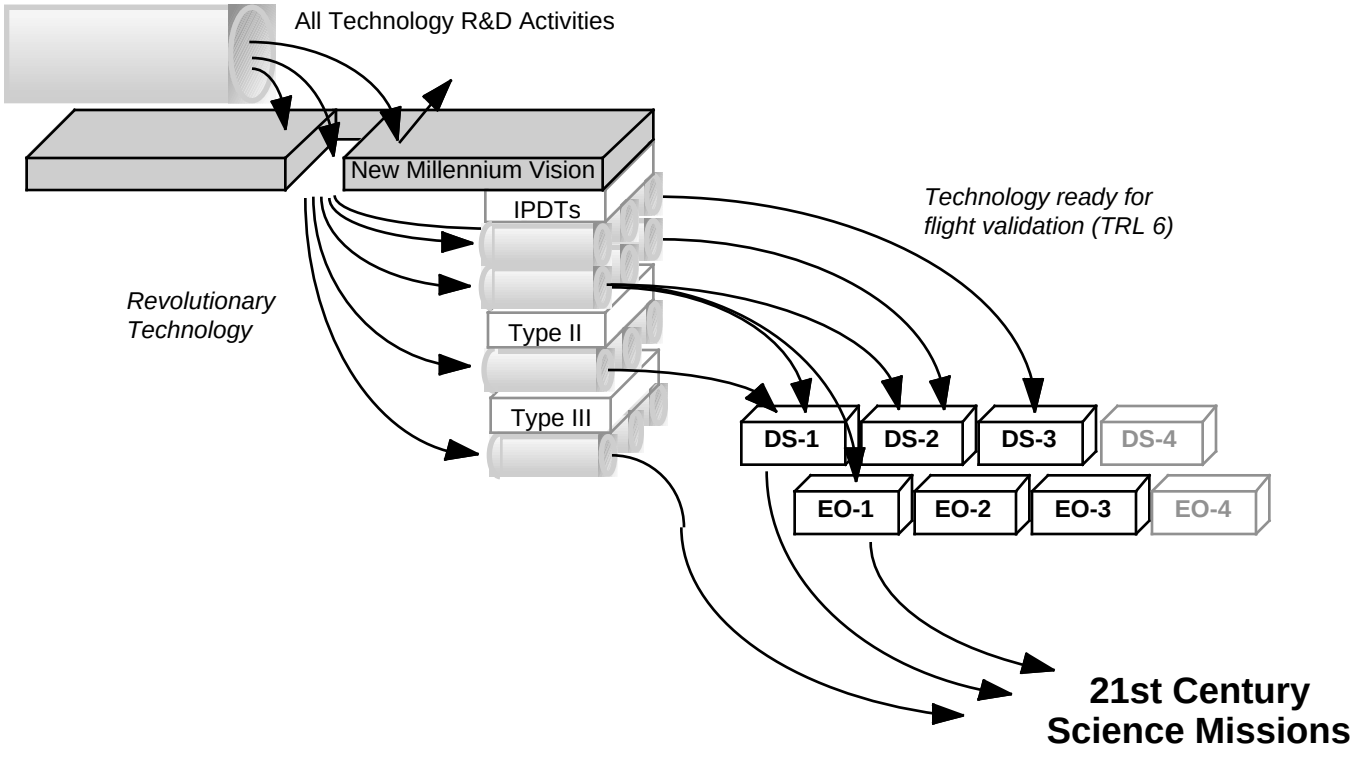
The technologies selected will provide leap-ahead capabilities, offering orders-of-magnitude advances in capability per cost. Such revolutionary technologies, even when demonstrated in the laboratory, are traditionally difficult for science missions to adopt due to the risk inherent in their first use. The NMP validation flights will demonstrate the ability of the new technologies to return meaningful science, and will be sufficiently challenging to fully test the performance under conditions that provide relevant heritage for future science missions. In this way, NMP fully bridges the gap between laboratory demonstration and proven flight readiness within a single program, thus ensuring the rapid infusion of these enabling technologies into science missions of the future.

NMP will also break new ground in developing innovative teaming relationships among industry, academia, nonprofit organizations and government that further the goals of all, creating a strong industrial infrastructure, enhancing educational opportunities, and providing affordable options for space and Earth science missions in the 21st century.

TECHNOLOGY INFUSION

- The New Millennium Program will continuously seek appropriate new technologies that support NASA's vision for the future
- The "National Technology Pipeline" will be the source of most ascendant technologies
- NMP Integrated Product Development Teams will provide the main path to NMP flight demonstrations
- Other routes to 21st century science mission applications are also available (especially if the technology does not need flight demonstration)

TECHNOLOGY PIPELINE



TECHNOLOGY TYPES

TYPE I

New technologies that the NMP Integrated Product Development Teams will provide for flight validation

TYPE II

Other new technologies that can / will be available for validation flights

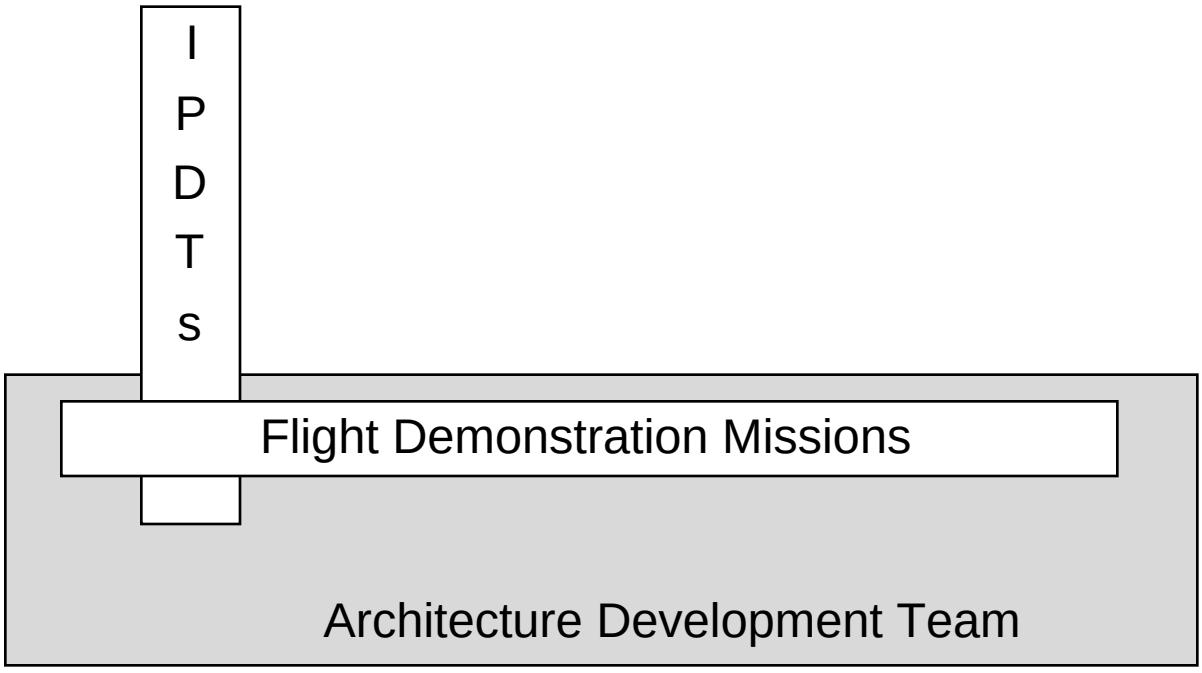
TYPE III

Technologies which are consistant with the New Millennium vision for 21st century science missions, and have been identified as supporting New Millennium Program objectives, but are not yet part of a defined flight validation mission

SPACE TECHNOLOGY READINESS LEVELS

Basic Research	LEVEL 1 - FUNDAMENTAL PRINCIPLES OBSERVED AND REPORTED
	LEVEL 2 - CONCEPT AND/OR APPLICATION FORMULATED
Research To Prove Feasibility	LEVEL 3 - CRITICAL FUNCTION AND/OR CHARACTERISTIC DEMONSTRATED (ANALYTICAL OR EXPERIMENTAL PROOF-OF-CONCEPT)
Technology Development	LEVEL 4 - COMPONENT AND/OR BREADBOARD FUNCTIONALITY VALIDATED IN A LABORATORY ENVIRONMENT
Technology Demonstration	LEVEL 5 - COMPONENT AND/OR BREADBOARD PERFORMANCE VALIDATED IN A RELEVANT ENVIRONMENT
	LEVEL 6 - SYSTEM/SUBSYSTEM MODEL OR PROTOTYPE DEMONSTRATED IN A RELEVANT ENVIRONMENT (Ground or Space)
System/Subsystem Development	LEVEL 7 - SYSTEM PROTOTYPE DEMONSTRATED IN A SPACE ENVIRONMENT
System Test, Launch & Operation	LEVEL 8 - FLIGHT SYSTEM COMPLETED AND "QUALIFIED" THROUGH TEST AND DEMONSTRATION (Ground or Flight)
	LEVEL 9 - ACTUAL SYSTEM "FLIGHT PROVEN" THROUGH SUCCESSFUL MISSION OPERATIONS

NEW MILLENNIUM PROGRAM ORGANIZATION STRUCTURE



NEW MILLENNIUM PROGRAM PARTICIPATION

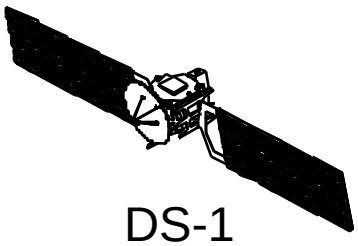
- Aerospace Companies
  - Lockheed-Martin, Boeing, TRW, Hughes, Loral, Ball, Honeywell, Olin, ITT
- SBIR Companies
  - SSG, NTEC, SCC, Optivision, L'Garde, Yardney, ISX, OCA, Microcosm
- Other Small Business Participation
  - Spectrum Astro, Southwest Research Institute
- Universities
  - Stanford, UCLA, UCSD, USC, U of MI, U of AZ, U of CO, MIT, U of MA, GIT
- NASA Centers
  - ARC: Autonomy, LeRC: MAMS , Comm., and Microelectronics, MSFC: IT&A
    LaRC: MAMS and IT&A, GSFC: IT&A, Comm., and Microelectronics
- Other Government Agencies / Labs
  - AF / PL, ARPA, NOAA, NSF, Lincoln Labs, Los Alamos, Sandia

NEW MILLENNIUM PROGRAM SMALL BUSINESS PARTICIPATION

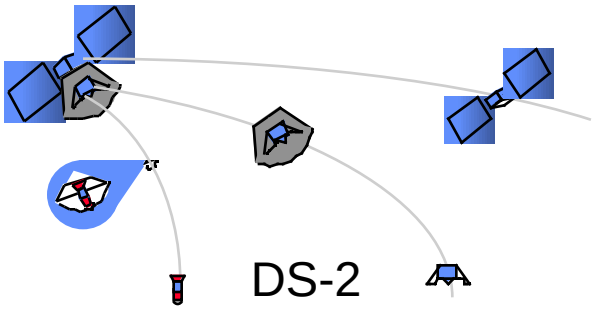
NMP partners from the SBIR program

- SSG (providing lightweight instrument structure / optics for DS-1)
- NTEC (providing Fresnel concentrator lenses on SCARLET array for DS-1)
- SCC (providing multi-chip-module stacks for DS-1 flight computer)
- Pacific Monolithics (providing MMICs for DS-1 SDST, and tiny transmitter)
- Yardney (developing lithium ion battery for flight validation)
- Optivision (participating in microelectronics technology roadmapping)
- L'Garde (participating in MAMS technology roadmapping)
- Microcosm (participating in autonomy technology roadmapping)
- OCA (participating in autonomy technology roadmapping)
- ISX (participating in autonomy technology roadmapping)

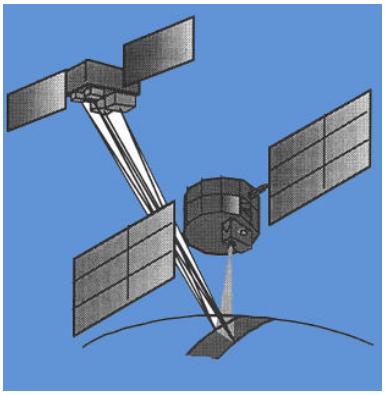
NEW MILLENNIUM PROGRAM FLIGHT VALIDATION CONCEPTS



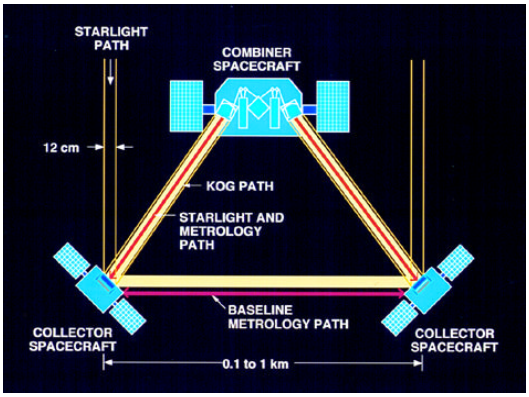
DS-1



DS-2



EO-1



DS-3

NEW MILLENNIUM PROGRAM INFORMATION

http://nmp.jpl.nasa.gov/

http://nmp.arc.nasa.gov/

NEW MILLENNIUM PROGRAM
FOCUSED TOPIC CONCEPT

- Most missions have been carried out by solitary spacecraft
- Trend is towards multiple spacecraft systems architectures
  - Constellations and networks for global coverage / 3D measurements
- Industry moving to low cost high capability spacecraft
  - Spin-off from government investment in SDI concepts, GPS, etc.
- Technology is enabling new measurements / architectures
  - Miniature / micro components, high density digital electronics, autonomy, ...
- Multiple cooperative spacecraft is emerging new architecture
  - Simultaneous cooperative operation to accomplish mission objectives

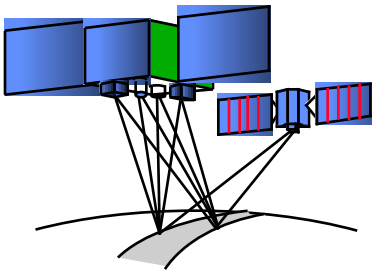
\+ ***MULTISPACECRAFT SYSTEMS***

SBIR FOCUSED TOPIC STRATEGY

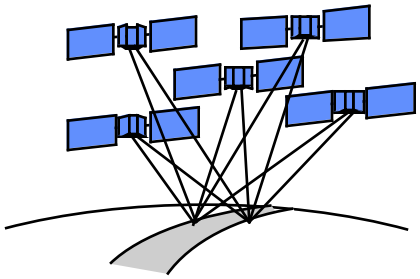
- Mentor industry participation in multispacecraft systems
  - Prepare small businesses to play a greater role
- Accelerate the growth of the emerging industry to produce low cost miniature / small spacecraft
- Integrate tightly with New Millennium Program
  - Target the next frontier of space system architectures
  - SBIR companies partner with NMP by joining an IPDT
  - Flight validation of leading edge technology
- Tie technology to NASA and commercial applications
  - NASA Near Earth and Deep Space Missions
  - A broad array of commercial missions / systems

MULTISPACECRAFT SYSTEM ARCHITECTURE CONCEPTS

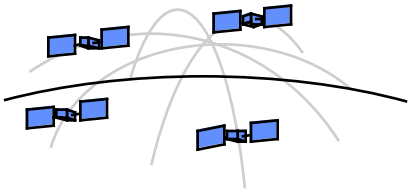
Near Earth



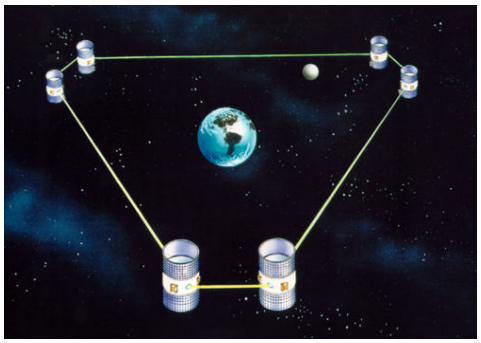
Instrument Replacement



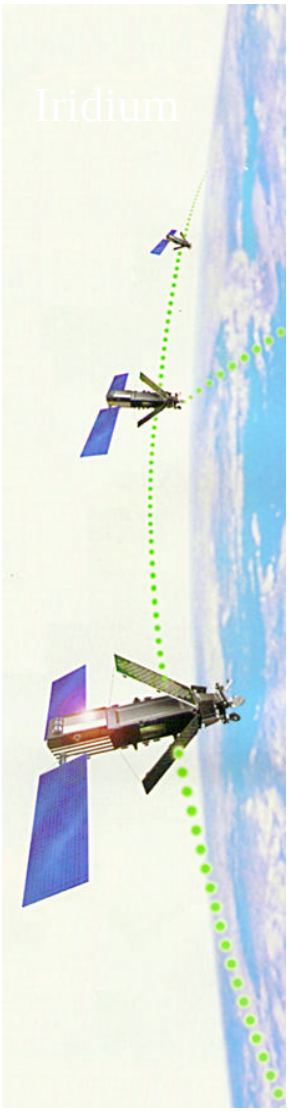
Virtual Platform



Constellation

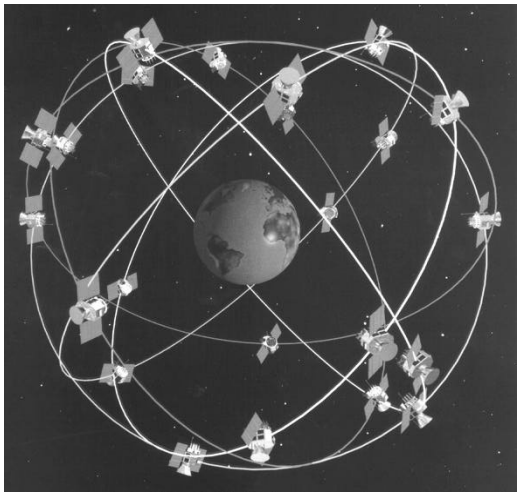


Virtual Instrument



Constellation Examples

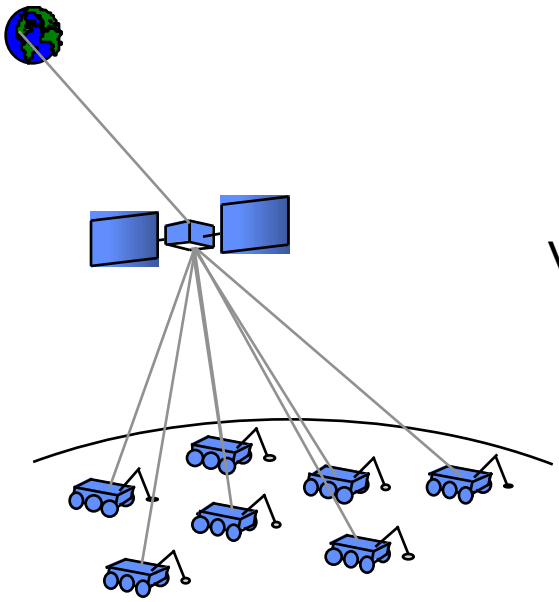
- NAVSTAR Global Positioning System Satellites (24 satellites/6 orbital planes)
- Constellation (formerly Aries) (48/4)
- ICO (formerly Inmarsat-P) (10/2)
- Teledesic (840/21)
- Globalstar (48/8)
- Odyssey (12/3)
- Iridium (66/6)
- Ellipso (10/2)



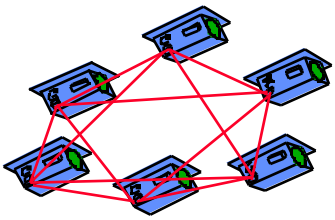
NAVSTAR GPS

MULTISPACECRAFT SYSTEM ARCHITECTURE CONCEPTS

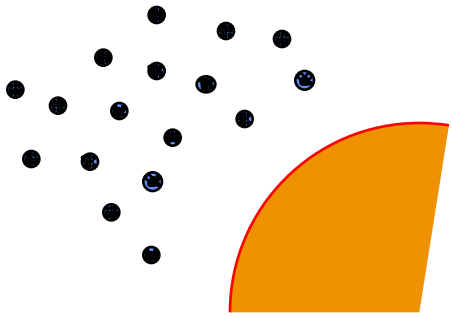
Deep Space



Network



Virtual Instrument



Swarm

Multispacecraft Systems Challenges

- Spacecraft-to-Spacecraft Coordination
  - Formation deployment and initialization
  - Multiple cross link communications
  - Combined communications and position sensing
  - Coordinated guidance, navigation, and control

- Multispacecraft System Operations
  - Distributed sensing (measurement / imaging)
  - Network data acquisition and processing
  - Formation control
  - Autonomous mission operations

- Multispacecraft Systems Engineering
  - Mission / systems design
  - Optimal task distribution
  - System testing & reliability

FOCUSED TOPIC STRUCTURE

Some Options for SBIR Involvement

(a) SBIR companies develop individual technology products
- NASA incorporates them individually into applicable missions

(b) SBIR companies develop technologies for target applications
- NASA tests and integrates them into specific missions

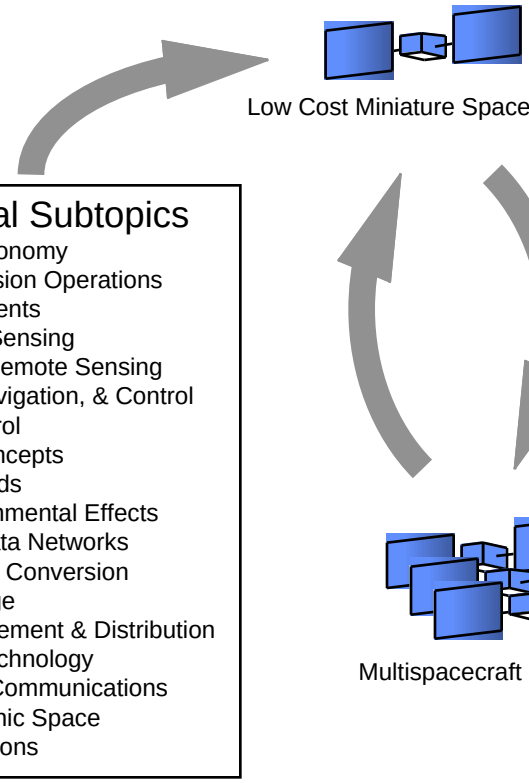
(c) SBIR companies do targeted application systems engineering
- NASA works in parallel on mission engineering

(d) SBIR companies team together to produce flight system
- NASA works in parallel to develop / launch / operate mission

(e) SBIR companies team together to develop / launch mission
- NASA integrates mission with program of similar missions

(f) Same as (e) but repeated annually

SBIR ACTIVITIES COORDINATION



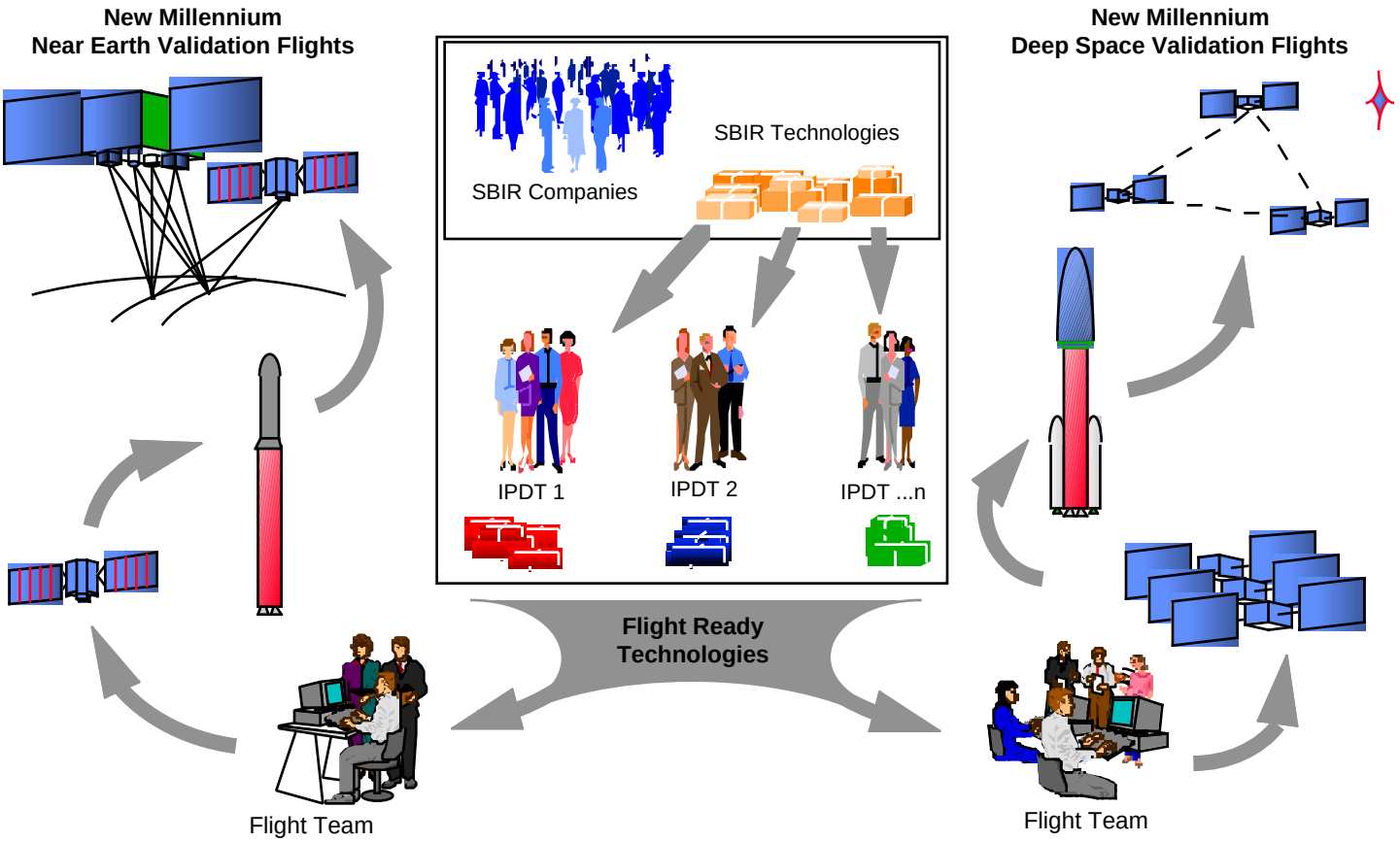
Technical Subtopics

- On-Board Autonomy
- Low Cost Mission Operations
- Micro-Instruments
- High Energy Sensing
- Commercial Remote Sensing
- Guidance, Navigation, & Control
- Thermal Control
- Advanced Concepts
- Design Methods
- Space Environmental Effects
- Spacecraft Data Networks
- Space Energy Conversion
- Energy Storage
- Power Management & Distribution
- Propulsion Technology
- Deep Space Communications
- Optical-Photonic Space Communications

Focused Topic

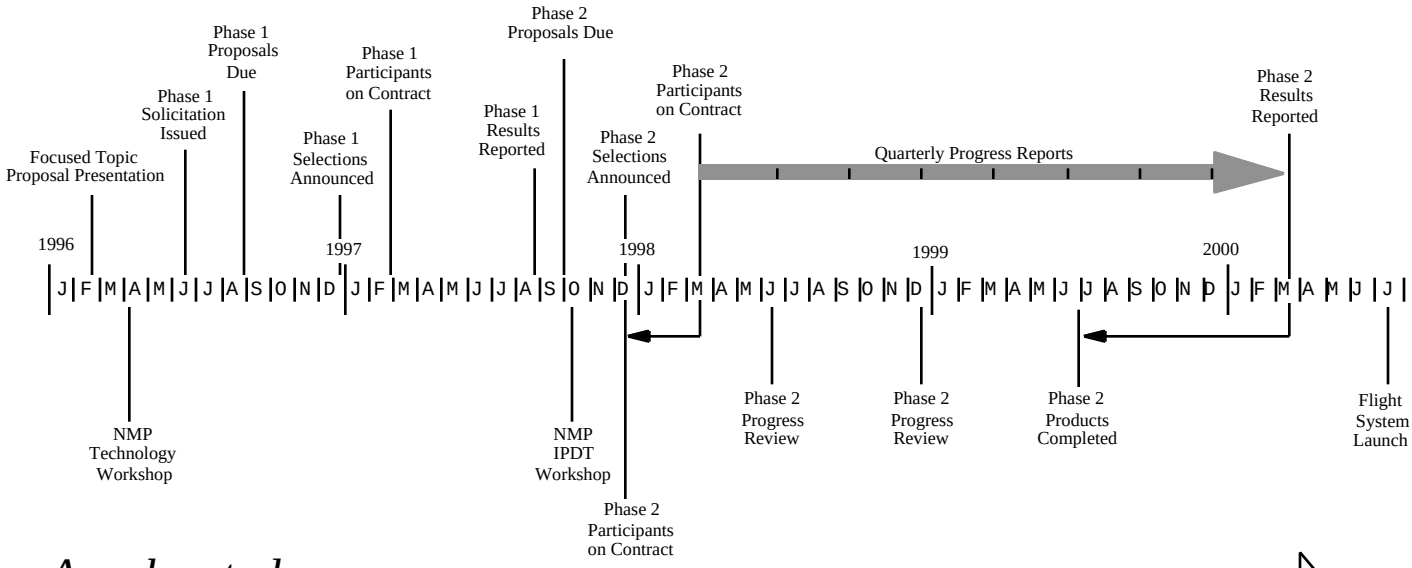
- Distributed Sensing & Measurement
- Coordinated Group Operations
- Multi-Cross Link Communications
- Formation Control
- Autonomous System Ops. / Mgmt.
-
-
- Autonomous Data Acq. & Processing
- Sensor and Data Fusion
- Micro-Thrust Precision Propulsion
- Multispacecraft Systems Engineering
- Distributed Network Data Processing

SBIR Involvement

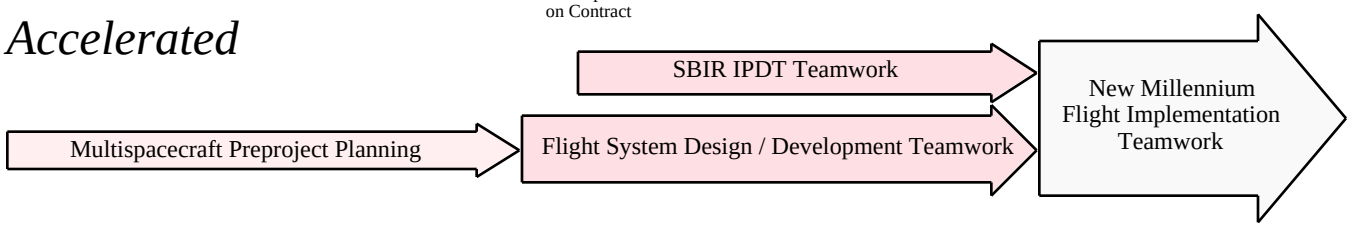


SBIR 96 PHASE 1&2 TIMELINE

Current



Accelerated



NEW MILLENNIUM PROGRAM
SBIR FOCUSED TOPIC SUMMARY

- Strengthens the tie between NASA needs and SBIR developments *(joint planning of technology needs / opportunities)*
- Increases the impact of SBIR technology developments on NASA Missions *(direct link between technology development & application planning)*
- Rapid infusion of new technology from small innovative companies into NASA missions *(flight validation proof of readiness for use)*
- Accelerates the growth of the emerging low cost miniature / small spacecraft industry *(teaming)*
- Provides opportunity for companies with high-risk technologies to demonstrate their technology rapidly
- Integrates New Millennium approach into SBIR activities
  - Innovative partnerships with industry / universities
  - Flight validation of leading edge technology